



EXPLORE GATEWAY

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The NASA Charge to the Moon

In keeping with SPD-1, NASA is charged with **landing the first American woman and next American man at the South Pole of the Moon by 2024**, followed by a sustained presence on and around the Moon by 2028.

NASA will **“use all means necessary”** to ensure mission success in moving us forward to the Moon.



Vice President Mike Pence speaks about NASA's mandate to return American astronauts to the Moon and on to Mars at the U.S. Space & Rocket Center in Huntsville, Alabama.

Why Go to the Moon?

Establishes American leadership and strategic presence

Proves technologies and capabilities for sending humans to Mars

Inspires a new generation and encourages careers in STEM

Leads civilization changing science and technology

Expands the U.S. global economic impact

Broadens U.S. industry & international partnerships in deep space

Phase 1 & Phase 2 Definitions

Phase 1: Today – 2024

Human surface landing

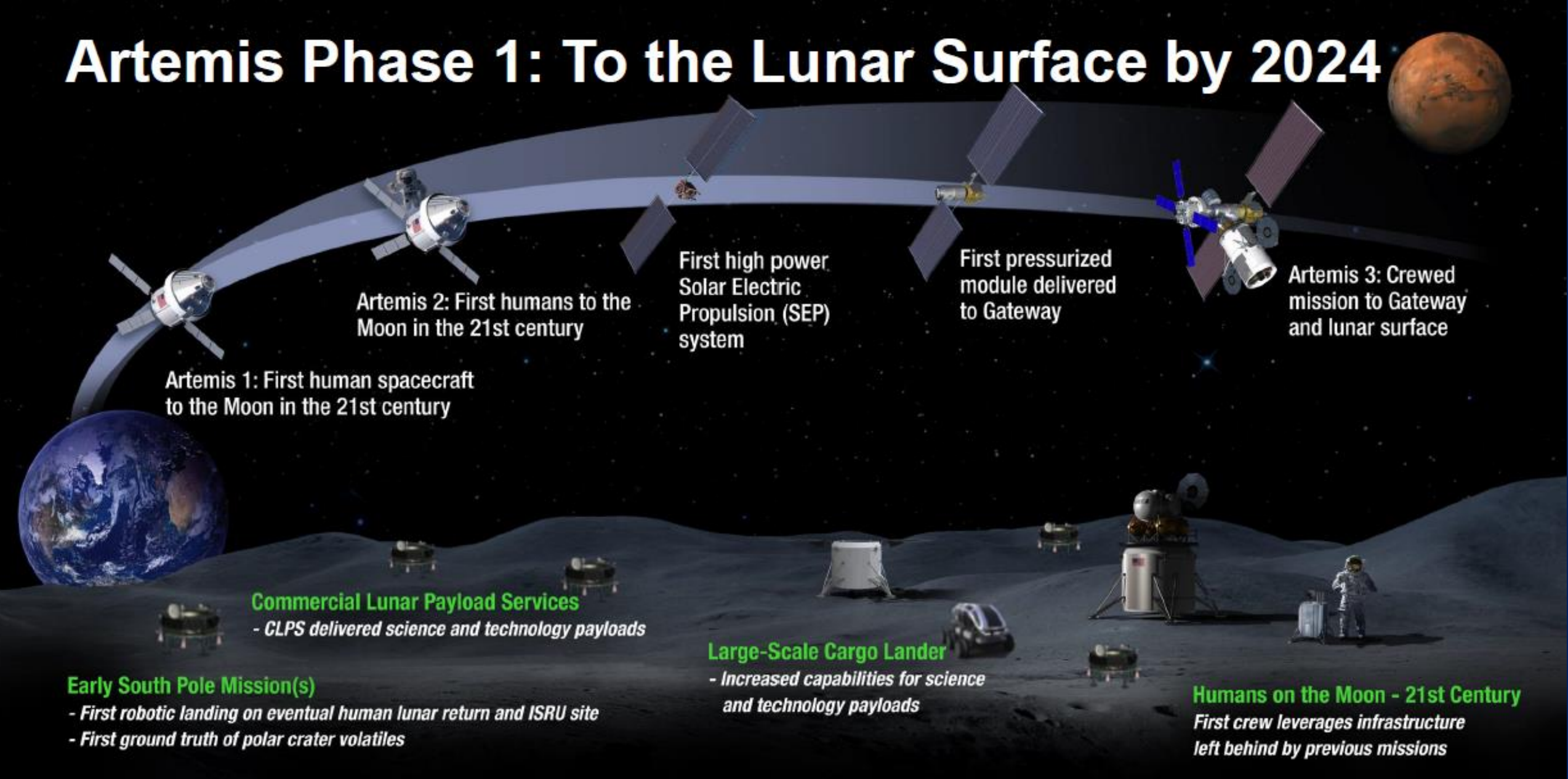
Missions and systems required to achieve landing humans on the surface of the Moon in 2024

Phase 2: 2024

Establish a sustainable long-term presence on and around the Moon



Artemis Phase 1: To the Lunar Surface by 2024



LUNAR SOUTH POLE TARGET SITE

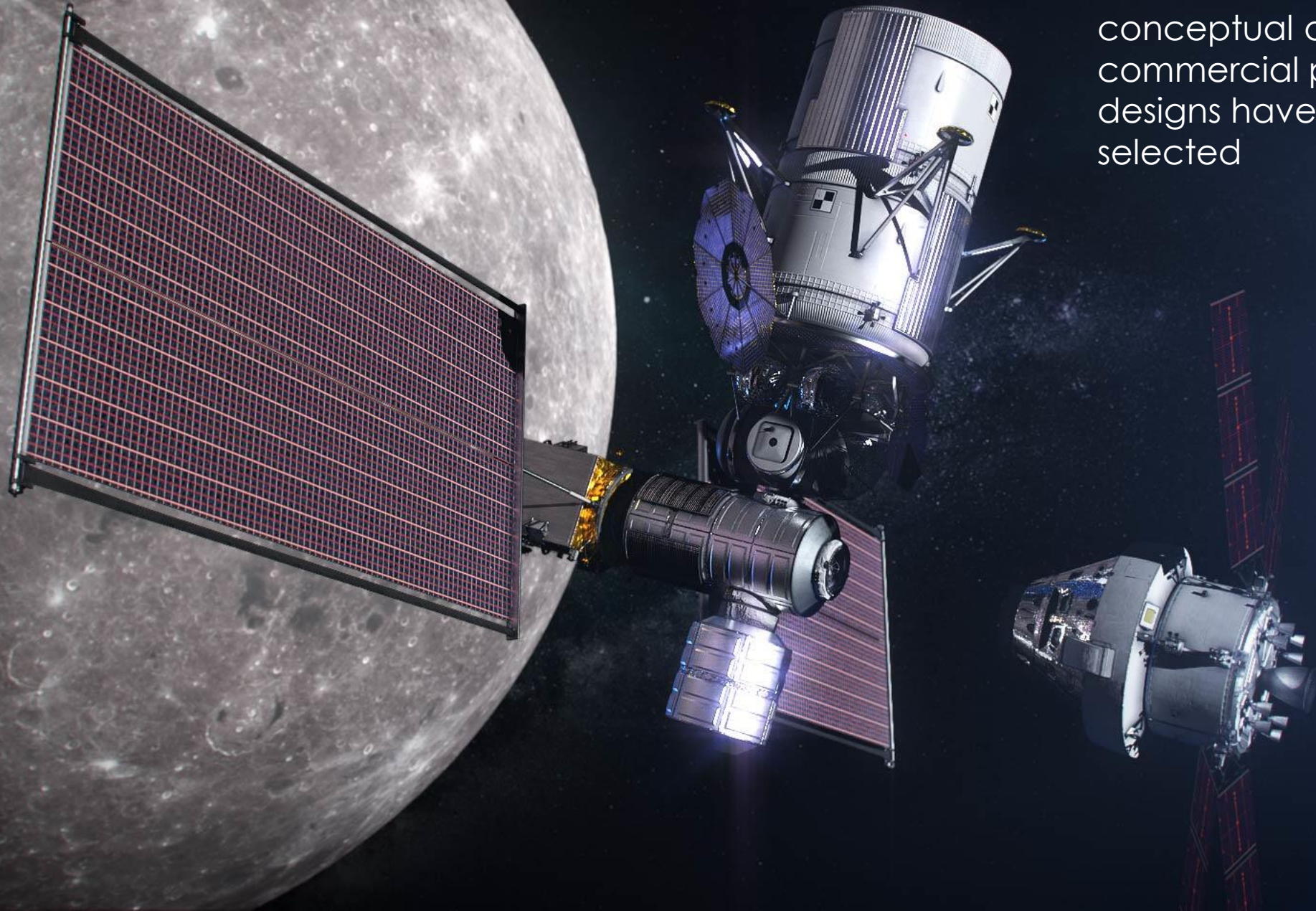
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2019

2024

PHASE 1 NOTIONAL 2024 CONCEPT

Elements shown are artist conceptual drawings, as commercial partners and designs have not been selected



POTENTIAL GATEWAY SCIENCE OPPORTUNITIES



CREWS LIVING AND WORKING IN THE DEEP SPACE ENVIRONMENT

- » Human health and performance associated with living and working in deep space



ELEMENTS WILL HAVE INTERNAL AND EXTERNAL PAYLOAD ACCOMMODATIONS

- » Earth science, heliophysics, astrophysics, lunar/planetary science, and fundamental physics
- » Technology and capability testing for future exploration destinations
- » Combined radiation effects and microgravity on biological organisms



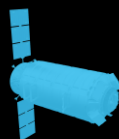
LUNAR SURFACE OPPORTUNITIES

- » Crewed and robotic surface missions
- » Sample return
- » Lander and systems development



OTHER CISLUNAR LOCATIONS ACCESSIBLE

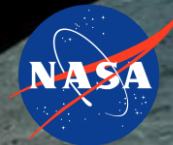
- » Potential for use of logistics modules as science platforms post departure from Gateway, including heliocentric disposal orbit
- » Variations of NRHO, Low Lunar Orbit, Distant Retrograde Orbit, Earth-Moon Lagrange Points



GATEWAY COMMUNICATIONS RELAY

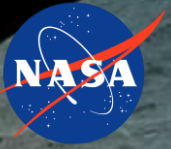
- » Coverage of lunar poles, craters/valleys and lunar farside not possible from Earth
- » Teleoperations of surface assets by crew or Earth-based operators
- » In support of small satellite communications relay

GATEWAY UTILIZATION RESOURCES



- **Gateway utilization resources are very limited compared to ISS**
 - Accommodations: small vehicle with little external real estate and limited internal volume and stowage
 - Upmass/downmass: infrequent logistics manifest upmass opportunities, Orion is currently the only downmass capability
 - Crew time: crew present only ~17 days/year initially (and 2 crew are on the moon surface for 7 of those days)
 - External payloads: limited # of attach points on Gateway, limited mass for launch, and limitations due to launch vehicle fairing
 - No Robotics capability until Phase 2, no EVA support to payloads
 - Gateway mission has significant scope beyond research
 - Not considered a “U.S. National Lab” and therefore NASA is not receiving National Lab funding
- **However, utilization is still important to all of the International Partner agencies, and multiple science disciplines and agencies must cooperate to use these limited resources**
- **Phase 1 payloads should be simple, require little crew time and downmass, and come plug-in ready**
 - Phase 1 has a tight schedule for integration
 - Science must already be ‘in the box’ when delivered, as the Gateway Program is not currently developing/delivering payloads or housings
 - No multi-use hardware is currently planned for Phase 1 (e.g., no glovebox)
- **Phase 1 goals, if design and mission can accommodate, include launching ~3 external payloads on elements and ~1 external payload launched on Logistics Module**
 - Goal to fly several internal payloads as well, in addition to having a staging area for lunar rocks/samples to transfer to the Orion crew return vehicle

GATEWAY UTILIZATION RESOURCES (CON'T)



- **PPE and MHC will have CSA-supplied external attachment fixtures for future arm operations and robotically-installed payloads**
 - Small ORU Robotics Interfaces (SORIs) and Low Profile Grapple Fixtures (LPGFs)
 - Numbers and locations are currently being analyzed for robotic access and structural limitations (e.g. radiators)
- **Gateway vehicle is still under design**
 - The vehicle is expected to be controlled mostly with gyros, but there will be times in the 6.5 day orbit when thrusters may fire
 - There will be a limited amount of propellant; note that external viewing (of Earth, sun, moon, deep space) may be affected by the resulting Gateway attitude constraints
 - Pointing requirements may in some cases have to be satisfied by payload (gimbaled)
 - Orion has windows; Gateway Phase 1 unlikely to have windows other than possibly small hatch windows
- **Please note that assumptions, resources, and capabilities are subject to change as design and mission requirements develop**

PAYLOAD INTERFACES



- **External payload interfaces:**

- External interfaces are to be provided by the Canadian Space Agency (see preliminary graphics)
- It is under investigation whether payloads can launch in place on SORIs; if so, they must be less than ~ 25 – 30 kg each, and low profile for launch
- CSA has published a related Request for Proposal (RFP):

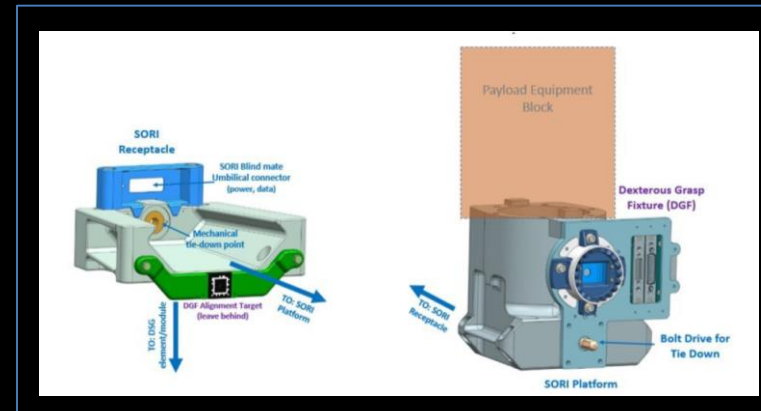
<https://buyandsell.gc.ca/procurement-data/tender-notice/PW-19-00871935>

- Below is a requirement document published as part of this RFP:

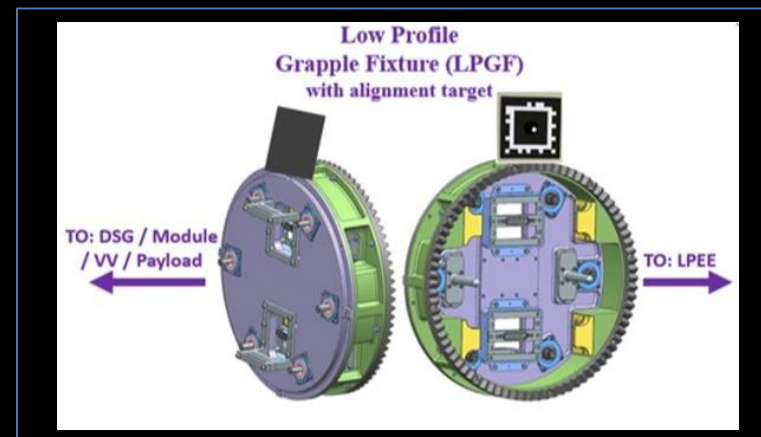
<ftp://ftp.asc-csa.gc.ca/users/geri/pub/CSA-GERI-RD-0001%20Rev%20B%20-%20GERI%20Mission%20Requirements%20Document.pdf>

- **Internal payload interface requirements are in development**

- Phase 1 resources for internal payloads likely limited to power, commanding/data, and cabin air cooling (e.g., no lockers, N2, vacuum access, potable water)
- Requirements and interface documentation is in work



Small ORU Robotics Interface (SORI)



Low Profile Grapple Fixture (LPGF)

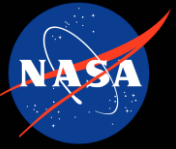
PAYLOAD INTERFACES

- **NASA and the Gateway Program are still defining Gateway requirements – design details are not available**
- **Gateway will adhere to the International Deep Space Interoperability Standards:**
<https://www.internationaldeepspacestandards.com/>
 - Seven standards defined to date: Avionics, Communications, ECLSS, Power, Rendezvous, Robotics, and Thermal
 - Gateway still evaluating which will apply to external payloads, to be documented in the Interface Definitions Document (IDD)
 - Robotics Standard defines interfaces for external payloads
- **External payloads may be transported externally or transported internally**
 - Transfer to/from internal locations may be provided later via a science airlock – incorporation of such an airlock is under consideration
- **Internally launched payloads would likely be launched in a bag in protected “foam”, with no hard mount during launch in the logistics element**
- **No EVA interaction is assumed for payloads**



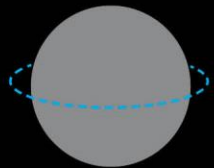
BACK-UP

GATEWAY ORBIT



Cislunar space offers innumerable orbits for consideration, each with merit for a variety of operations. The Gateway will support missions to the lunar surface and serve as a staging area for exploration farther into the solar system, including Mars.

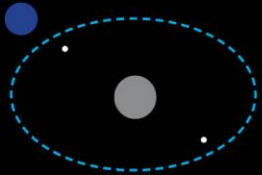
ORBIT TYPES



LOW LUNAR ORBITS

Circular or elliptical orbits close to the surface. Excellent for remote sensing, difficult to maintain in gravity well.

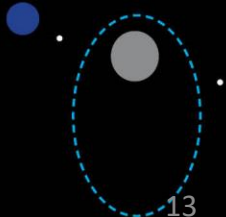
» Orbit period: 2 hours



DISTANT RETRO-GRADE ORBITS

Very large, circular, stable orbits. Easy to reach from Earth, but far from lunar surface.

» Orbit period: 2 weeks



HALO ORBITS

Fuel-efficient orbits revolving around Earth-Moon neutral-gravity points.

» Orbit period: 1-2 weeks

NEAR-RECTILINEAR HALO ORBIT (NRHO)

1,500 km at its closest to the lunar surface, 70,000 km at its farthest.



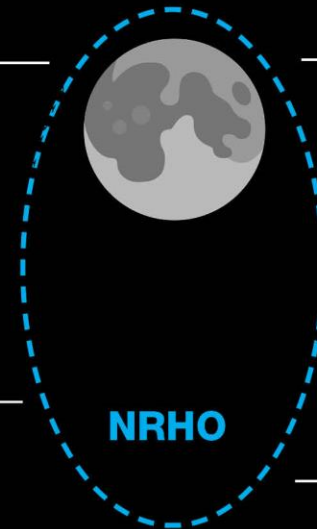
ACCESS

Easy to access from Earth orbit with many current launch vehicles. Staging point for both lunar surface and deep space destinations.



ENVIRONMENT

Deep space environment useful for radiation testing and experiments in preparation for missions to the lunar surface and Mars.



SCIENCE

Favorable vantage point for Earth, sun and deep space observations.



COMMUNICATIONS

Provides continuous view of Earth and communication relay for lunar farside.



SURFACE OPERATIONS

Supports surface telerobotics, including lunar farside. Provides a staging point for planetary sample return missions.

